



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/628,297	07/25/2003	David H. Gracias	42P17076	5374

7590 03/02/2004

Edwin H. Taylor
Blakely, Sokoloff, Taylor & Zafman LLP
Seventh Floor
12400 Wilshire Boulevard
Los Angeles, CA 90025-1030

EXAMINER

PERKINS, PAMELA E

ART UNIT	PAPER NUMBER
----------	--------------

2822

DATE MAILED: 03/02/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/628,297

Applicant(s)

GRACIAS ET AL.

Examiner

Pamela E Perkins

Art Unit

2822

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 25 July 2003.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-34 is/are pending in the application.
- 4a) Of the above claim(s) 27-34 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-26 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 25 July 2003 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____.
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

DETAILED ACTION

This office action is in response to the filing of the application papers on 24 July 2003. Claims 1-34 are pending; claims 27-24 have been withdrawn from consideration.

Election/Restrictions

Restriction to one of the following inventions is required under 35 U.S.C. 121:

- I. Claims 1-26, drawn to a method of manufacturing a semiconductor device, classified in class 438, subclass 618.
- II. Claims 27-34, drawn to a semiconductor device, classified in class 257, subclass 774.

The inventions are distinct, each from the other because of the following reasons:

Inventions I and II are related as process of making and product made. The inventions are distinct if either or both of the following can be shown: (1) that the process as claimed can be used to make other and materially different product or (2) that the product as claimed can be made by another and materially different process (MPEP § 806.05(f)). In the instant case the product as claimed can be made by another and materially different process. For example, the product as claimed may be formed with desorbing or removing the sealant layer as required by the process as claimed.

Because these inventions are distinct for the reasons given above and have acquired a separate status in the art as shown by their different classification, restriction for examination purposes as indicated is proper.

During a telephone conversation with Edwin Taylor on 12 January 2004 a provisional election was made without traverse to prosecute the invention of the method

of manufacturing a semiconductor device, claims 1-26. Affirmation of this election must be made by applicant in replying to this Office action. Claims 27-34 are withdrawn from further consideration by the examiner, 37 CFR 1.142(b), as being drawn to a non-elected invention.

Applicant is reminded that upon the cancellation of claims to a non-elected invention, the inventorship must be amended in compliance with 37 CFR 1.48(b) if one or more of the currently named inventors is no longer an inventor of at least one claim remaining in the application. Any amendment of inventorship must be accompanied by a request under 37 CFR 1.48(b) and by the fee required under 37 CFR 1.17(i).

Drawings

The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they include the following reference sign(s) not mentioned in the description: 405, 415, see Fig. 4a; 505, 515, see Fig. 5a; 605, 610, see Fig. 6a. A proposed drawing correction, corrected drawings, or amendment to the specification to add the reference sign(s) in the description, are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and

Art Unit: 2822

the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1, 2, 4-6 and 12-18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Raaijmakers et al. (6,482,733) in view of Clem et al. (6,518,168).

Raaijmaker et al. disclose a method where an interlayer dielectric (50) is formed on an underlying layer (74), the underlying layer (74) having an underlying conductor (52) (Fig. 9c); etching a via (62) and a trench (60) in the interlayer dielectric (50) exposing at least a portion of the underlying conductor (52) (col. 9, line 14 thru col. 10, line 8); forming an organic monolayer (148) on the exposed portion of the underlying conductor (52); sealing the surfaces of the interlayer dielectric (50), so as to line the via (62) and the trench (60) with a thin dense film by exposing the surface of the interlayer dielectric (50) to plasma (col. 15, line 4 thru col. 16, line 48); and forming a barrier layer (150) over the surface of the interlayer dielectric (50) (col. 25, lines 51-61). Raaijmaker et al. further disclose the barrier layer (150) comprises tantalum; the metal conductor (52) comprises copper and the dielectric material (50) comprises an oxide or a polymer. Raaijmaker et al. also disclose forming the organic monolayers (148) by dip-coating, spin-coating or spray on (col. 12, line 19 thru col. 13, line 47). Raaijmaker et al. disclose the interlayer dielectric (52) comprises dielectric material and pores (Fig. 10b; col. 14, lines 11-47). Raaijmaker et al. do not disclose removing the organic monolayer, re-exposing the portion of the underlying conductor.

Clem et al. disclose a method where an interlayer dielectric is formed on an underlying layer, the underlying layer having an underlying conductor; etching a trench in the interlayer dielectric; forming an organic monolayer on the exposed portion of the

underlying conductor; sealing the surfaces of the interlayer dielectric (Fig. 1a-1d; col. 6 lines 14-59); and removing the organic monolayer, re-exposing the portion of the underlying conductor (col. 23, lines 28-42).

Since Raaijmaker et al. and Clem et al. are both from the same field of endeavor, a method of manufacturing a semiconductor device, the purpose disclosed by Clem et al. would have been recognized in the pertinent art of Raaijmaker et al. Therefore, it would have been obvious to one ordinary skill in the art at the time the invention was made to modify Raaijmaker et al. by removing the organic monolayer, re-exposing the portion of the underlying conductor as taught by Clem et al. to reduce waste (col. 2, lines 22-29).

Claims 7 and 8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Raaijmakers et al. in view of Clem et al. as applied to claims 1, 2, 4-6 and 12-18 above, and further in view of Obeng et al. (6,323,131).

Raaijmaker et al. in view of Clem et al. disclose the claimed subject matter except the organic monolayer comprises a functionalized long chain organic molecule, wherein the functionalized long chain organic molecule is selected from the group consisting of thiols, phosphines, amines, alcohols, carbonyls, or carboxylic acids.

Obeng et al. disclose a method where an interlayer dielectric (10) is formed on an underlying layer (12), the underlying layer (12) having an underlying conductor; etching a via and a trench (16) in the interlayer dielectric (10) exposing at least a portion of the underlying conductor; forming an organic monolayer (14) on the exposed portion of the underlying conductor; sealing the surfaces of the interlayer dielectric (10), so as

Art Unit: 2822

to line the via and the trench (16) with a thin dense film by exposing the surface of the interlayer dielectric (10) to plasma; and forming a barrier layer (18) over the surface of the interlayer dielectric (10) (col. 4, lines 8-35). Obeng et al. further disclose the organic monolayer (14) comprises a functionalized long chain organic molecule, wherein the functionalized long chain organic molecule is selected from the group consisting of thiols, phosphines, amines, alcohols, carbonyls, or carboxylic acids (col. 2, line 62 thru col. 3, line 22).

Since Raaijmaker et al. and Obeng et al. are both from the same field of endeavor, a method of manufacturing a semiconductor device, the purpose disclosed by Obeng et al. would have been recognized in the pertinent art of Raaijmaker et al. Therefore, it would have been obvious to one ordinary skill in the art at the time the invention was made to modify Raaijmaker et al. by the organic monolayer comprises a functionalized long chain organic molecule, wherein the functionalized long chain organic molecule is selected from the group consisting of thiols, phosphines, amines, alcohols, carbonyls, or carboxylic acids as taught by Obeng et al. to prevent air corrosion (col. 2, lines 17-31).

Claim 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over Raaijmakers et al. in view of Clem et al. as applied to claims 1, 2, 4-6 and 12-18 above, and further in view of Mangat et al. (6,297,169).

Raaijmaker et al. in view of Clem et al. disclose the claimed subject matter except removing the organic monolayer by thermal processing.

Mangat et al. disclose a method where an interlayer dielectric (84) is formed on an underlying layer (62), the underlying layer (62) having an underlying conductor (82); forming an organic monolayer (220) on the underlying conductor (82); and re-exposing the portion of the underlying conductor (col. 3, line 44 thru col. 4, line 39). Mangat et al. further disclose removing the organic monolayer (220) by thermal processing (col. 4, lines 59-65).

Since Raaijmaker et al. and Mangat et al. are both from the same field of endeavor, a method of manufacturing a semiconductor device, the purpose disclosed by Mangat et al. would have been recognized in the pertinent art of Raaijmaker et al. Therefore, it would have been obvious to one ordinary skill in the art at the time the invention was made to modify Raaijmaker et al. by removing the organic monolayer by thermal processing as taught by Mangat et al. to remove defects (col. 4, lines 40-58).

Claim 10 is rejected under 35 U.S.C. 103(a) as being unpatentable over Raaijmakers et al. in view of Clem et al. as applied to claims 1, 2, 4-6 and 12-18 above, and further in view of Jackson (5,236,602).

Raaijmaker et al. in view of Clem et al. disclose the claimed subject matter except removing the organic monolayer by oxidation.

Jackson discloses a method where an organic monolayer is formed over a semiconductor substrate. Jackson further discloses removing the organic monolayer by oxidation (col. 2, lines 5-29).

Since Raaijmaker et al. and Jackson are both from the same field of endeavor, a method of manufacturing a semiconductor device, the purpose disclosed by Jackson

would have been recognized in the pertinent art of Raaijmaker et al. Therefore, it would have been obvious to one ordinary skill in the art at the time the invention was made to modify Raaijmaker et al. by removing the organic monolayer by oxidation as taught by Jackson to clean the substrate (col. 2, lines 5-29).

Claims 3, 11, 19 and 24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Raaijmakers et al. in view of Clem et al. as applied to claims 1, 2, 4-6 and 12-18 above, and further in view of Soininen et al. (6,482,740).

Raaijmaker et al. in view of Clem et al. disclose the claimed subject matter except selecting the thin dense film from a group consisting of SiN, SiO₂, or SiC and oxidizing the organic monolayer using formaldehyde.

Soininen et al. disclose a method where an interlayer dielectric (8) is formed on an underlying layer (4), the underlying layer (4) having an underlying conductor (2); etching a via and a trench in the interlayer dielectric (8) exposing at least a portion of the underlying conductor (2); forming an organic monolayer on the exposed portion of the underlying conductor (2); sealing the surfaces of the interlayer dielectric (8), so as to line the via and the trench with a thin dense film by exposing the surface of the interlayer dielectric (8) to plasma, wherein selecting the thin dense film from a group consisting of SiN, SiO₂, or SiC; and forming a barrier layer (14) over the surface of the interlayer dielectric (8) (col. 5, lines 46-58). Soininen et al. further disclose removing the organic monolayer by oxidation and oxidizing the organic monolayer using formaldehyde (col. 2, lines 7-26).

Since Raaijmaker et al. and Soininen et al. are both from the same field of endeavor, a method of manufacturing a semiconductor device, the purpose disclosed by Soininen et al. would have been recognized in the pertinent art of Raaijmaker et al. Therefore, it would have been obvious to one ordinary skill in the art at the time the invention was made to modify Raaijmaker et al. by selecting the thin dense film from a group consisting of SiN, SiO₂, or SiC and oxidizing the organic monolayer using formaldehyde as taught by Soininen et al. to have uniform thickness (col. 2, lines 65-67).

Claims 20-23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Raaijmaker et al. in view of Clem et al. and Soininen et al. as applied to claims 19 and 24 above, and further in view of Obeng et al.

Raaijmaker et al. in view of Clem et al. and Soininen et al. disclose the claimed subject matter except the organic monolayer comprises a functionalized long chain organic molecule, wherein the functionalized long chain organic molecule is selected from the group consisting of thiols, phosphines, amines, alcohols, carbonyls, or carboxylic acids.

Obeng et al. disclose a method where an interlayer dielectric (10) is formed on an underlying layer (12), the underlying layer (12) having an underlying conductor; etching a via and a trench (16) in the interlayer dielectric (10) exposing at least a portion of the underlying conductor; forming an organic monolayer (14) on the exposed portion of the underlying conductor; sealing the surfaces of the interlayer dielectric (10), so as to line the via and the trench (16) with a thin dense film by exposing the surface of the

interlayer dielectric (10) to plasma; and forming a barrier layer (18) over the surface of the interlayer dielectric (10) (col. 4, lines 8-35). Obeng et al. further disclose the organic monolayer (14) comprises a functionalized long chain organic molecule, wherein the functionalized long chain organic molecule is selected from the group consisting of thiols, phosphines, amines, alcohols, carbonyls, or carboxylic acids (col. 2, line 62 thru col. 3, line 22).

Since Raaijmaker et al. and Obeng et al. are both from the same field of endeavor, a method of manufacturing a semiconductor device, the purpose disclosed by Obeng et al. would have been recognized in the pertinent art of Raaijmaker et al. Therefore, it would have been obvious to one ordinary skill in the art at the time the invention was made to modify Raaijmaker et al. by the organic monolayer comprises a functionalized long chain organic molecule, wherein the functionalized long chain organic molecule is selected from the group consisting of thiols, phosphines, amines, alcohols, carbonyls, or carboxylic acids as taught by Obeng et al. to prevent air corrosion (col. 2, lines 17-31).

Claim 25 is rejected under 35 U.S.C. 103(a) as being unpatentable over Raaijmakers et al. in view of Clem et al. and Soininen et al. as applied to claims 19 and 24 above, and further in view of Mangat et al.

Raaijmaker et al. in view of Clem et al. and Soininen et al. disclose the claimed subject matter except removing the organic monolayer by thermal processing.

Mangat et al. disclose a method where an interlayer dielectric (84) is formed on an underlying layer (62), the underlying layer (62) having an underlying conductor (82);

forming an organic monolayer (220) on the underlying conductor (82); and re-exposing the portion of the underlying conductor (col. 3, line 44 thru col. 4, line 39). Mangat et al. further disclose removing the organic monolayer (220) by thermal processing (col. 4, lines 59-65).

Since Raaijmaker et al. and Mangat et al. are both from the same field of endeavor, a method of manufacturing a semiconductor device, the purpose disclosed by Mangat et al. would have been recognized in the pertinent art of Raaijmaker et al. Therefore, it would have been obvious to one ordinary skill in the art at the time the invention was made to modify Raaijmaker et al. by removing the organic monolayer by thermal processing as taught by Mangat et al. to remove defects (col. 4, lines 40-58).

Claim 26 is rejected under 35 U.S.C. 103(a) as being unpatentable over Raaijmakers et al. in view of Clem et al. and Soininen et al. as applied to claims 19-24 above, and further in view of Jackson.

Raaijmaker et al. in view of Clem et al. and Soininen et al. disclose the claimed subject matter except removing the organic monolayer by oxidation.

Jackson discloses a method where an organic monolayer is formed over a semiconductor substrate. Jackson further discloses removing the organic monolayer by oxidation (col. 2, lines 5-29).

Since Raaijmaker et al. and Jackson are both from the same field of endeavor, a method of manufacturing a semiconductor device, the purpose disclosed by Jackson would have been recognized in the pertinent art of Raaijmaker et al. Therefore, it would have been obvious to one ordinary skill in the art at the time the invention was made to

modify Raaijmaker et al. by removing the organic monolayer by oxidation as taught by Jackson to clean the substrate (col. 2, lines 5-29).

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Pamela E Perkins whose telephone number is (571) 272-1840. The examiner can normally be reached on Monday thru Friday, 9:00am to 5:30pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amir Zarabian can be reached on (571) 272-1852. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

PEP


AMIR ZARABIAN
UNITED STATES PATENT EXAMINER
JAN 12 2000